

ITU-T

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STANDARDIZATION SECTOR
OF ITU

G.984.6

Amendment 1

(11/2009)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
DIGITAL SYSTEMS AND NETWORKS

Digital sections and digital line system – Optical line
systems for local and access networks

Gigabit-capable passive optical networks (GPON):
Reach extension

**Amendment 1: Wavelength-converting,
continuous mode, and 1:N-protected range
extenders**

Recommendation ITU-T G.984.6 (2008) –
Amendment 1

15ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TRANSMISSION MEDIA AND OPTICAL SYSTEMS CHARACTERISTICS	G.600–G.699
DIGITAL TERMINAL EQUIPMENTS	G.700–G.799
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999
General	G.900–G.909
Parameters for optical fibre cable systems	G.910–G.919
Digital sections at hierarchical bit rates based on a bit rate of 2048 kbit/s	G.920–G.929
Digital line transmission systems on cable at non-hierarchical bit rates	G.930–G.939
Digital line systems provided by FDM transmission bearers	G.940–G.949
Digital line systems	G.950–G.959
Digital section and digital transmission systems for customer access to ISDN	G.960–G.969
Optical fibre submarine cable systems	G.970–G.979
Optical line systems for local and access networks	G.980–G.989
Access networks	G.990–G.999
MULTIMEDIA QUALITY OF SERVICE AND PERFORMANCE – GENERIC AND USER-RELATED ASPECTS	G.1000–G.1999
TRANSMISSION MEDIA CHARACTERISTICS	G.6000–G.6999
DATA OVER TRANSPORT – GENERIC ASPECTS	G.7000–G.7999
PACKET OVER TRANSPORT ASPECTS	G.8000–G.8999
ACCESS NETWORKS	G.9000–G.9999

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T G.984.6

Gigabit-capable passive optical networks (GPON): Reach extension

Amendment 1

Wavelength-converting, continuous mode, and 1:N-protected range extenders

Summary

Amendment 1 to Recommendation ITU-T G.984.6 is aimed at defining several additional features or types of reach extender units, including:

- Wavelength-converting reach extenders.
- Continuous mode reach extenders.
- 1:N protected reach extenders.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T G.984.6	2008-03-29	15
1.1	ITU-T G.984.6 (2008) Amend. 1	2009-11-13	15

FOREWORD

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CONTENTS

	Page
1) Changes to clause 1 "Scope"	1
2) Changes to clause 3 "Definitions"	1
3) Changes to clause 4 "Abbreviations and acronyms"	2
4) Changes to clause 6 "Optical extension schemes and architectures"	2
5) New clause 6.4 "Wavelength conversion reach extenders"	5
6) New clause 6.5 "Wavelength re-conversion at OLT"	6
7) New clause 8.6 "WDM wavelength allocation plan for OTL"	9
8) New Appendix VI "Extender-based type B protection scheme"	10
9) New Appendix VII "Possible realization of OA and OEO-based extenders using wavelength conversion"	12
10) New Appendix VIII "Transport of BM-to-CM converted signals over OTN"	18

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Recommendation ITU-T G.984.6

Gigabit-capable passive optical networks (GPON): Reach extension

Amendment 1

Wavelength-converting, continuous mode, and 1:N-protected range extenders

This amendment lists the changes necessary to accommodate the wavelength conversion (WC) function in the ITU-T G.984.6 architecture.

1) Changes to clause 1 "Scope"

Add the following after the last paragraph of clause 1:

Optionally, optical-electrical-optical converter (OEO) type reach extender (RE) units may support a burst mode (BM) to continuous mode (CM) conversion function, as specified in clause 6.2. In this case, it is also necessary to introduce a CM to BM conversion function before the S/R interface at the OLT.

Optionally, both optical amplifier (OA) and OEO type RE units may support the WC function, as specified in clause 6.4. In case of WC-enabled RE units, it is also necessary to introduce a WC function block before the S/R interface.

The optional support of type B protection in RE units is described in Appendix VI.

2) Changes to clause 3 "Definitions"

Replace the text of clause 3 with the following:

This Recommendation defines the following term:

3.1 wavelength conversion (WC): Any type of technology used to convert the frequency (wavelength) of the incoming optical signal λ_{input} into any λ_{output} from a predefined wavelength grid. In case of $\lambda_{\text{output}} \neq \lambda_{\text{input}}$, true wavelength conversion takes place, while if $\lambda_{\text{output}} = \lambda_{\text{input}}$, a wavelength-transparent WC function is used, where the frequency of the optical signal does not change when passing through the WC function. Utilization of a wavelength-transparent WC function does not imply the optical path transparency to data rate modulation format. Several WC technologies are available, including wavelength-tuneable lasers, laser arrays, all-optical wavelength conversion and seed wavelength modulation.

CMGPON_D – The name given to the continuous mode GPON downstream bit-stream signal.

CMGPON_U – The name given to the continuous mode GPON upstream bit-stream signal.

3) Changes to clause 4 "Abbreviations and acronyms"

Add the following to clause 4:

AWG	Arrayed Waveguide Grating
BC	Burst Mode
BLS	Broadband Light Source
BM-to-CM	Burst Mode to Continuous Mode
CID	Consecutive Identical Digits
CM	Continuous Mode
CM-to-BM	Continuous Mode to Burst Mode
DWDM	Dense wavelength Division Multiplexing
LC	Local Controller
NRZ	Non-Return to Zero
OWC	Optical Wavelength Conversion
RE	Reach Extender/Reach Extension
SNI	Service Node Interface
UNI	User Network Interface
WC	Wavelength Conversion
WC-RE	Wavelength Conversion-enabled Reach Extender unit
WDM	Wavelength Division Multiplexing
XGM	Cross-Grain Modulation

4) Changes to clause 6 "Optical extension schemes and architectures"

Add the following text immediately after Figure 2:

An extended architecture considered in this Recommendation is presented in Figure 2a. A WC-enabled RE unit is inserted between the ODN (compliant with existing PON Recommendations) and an optical trunk line (OTL), which is connected to the OLT. This architecture extends the reach of the PON by the length of the OTL, and may also increase the split ratio of the PON. Additionally, the WC-RE unit may aggregate several GPON-class ODNs, enabled by the wavelength division multiplexing (WDM) multiplexing over OTL to achieve more cost-efficient use of existing fibre infrastructure. The WC function block inserted before the S/R interface at the OLT performs adaptation between the WDM optical signals transmitted over the OTL and the ITU-T G.984.x-series compliant OLT interfaces.

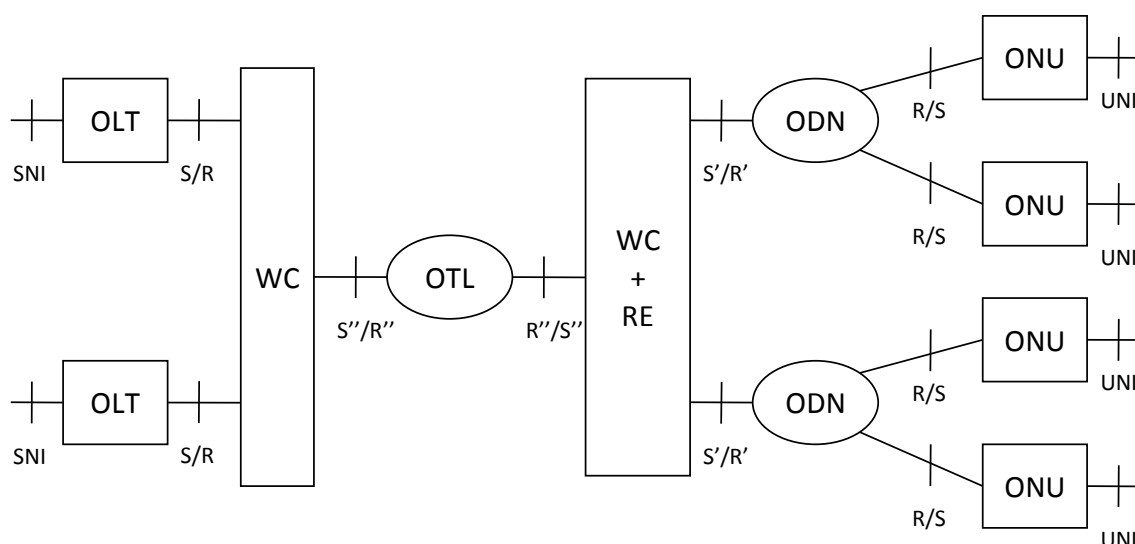


Figure 2a – Wavelength conversion reach extender architecture

An additional extended architecture considered in this architecture is shown in Figure 2b. A BM-to-CM converter is used at the remote PON reach extender to convert the bursty upstream signal into a conventional continuous mode signal. A CM-to-BM converter is theoretically present at the OLT location, although it will most likely be integrated within the OLT itself.

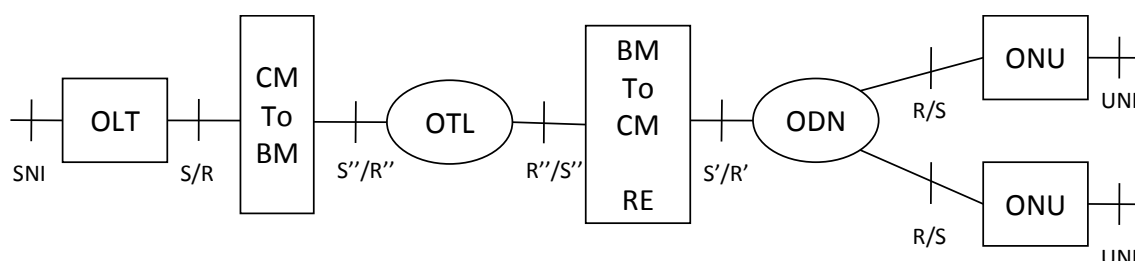


Figure 2b – BM-to-CM conversion reach extender architecture

Add the following text at the end of clause 6.2:

The continuous mode OEO RE is a subtype of OEO RE. The S'/R' interface of CM OEO RE is the same as the one of OEO RE. In CM RE, a BM-to-CM converter is used to convert the burst signal to a continuous signal. The downstream signal (denoted CMGPON_D) has a bit rate of 2.48832 Gbit/s, and a frequency accuracy of 32 ppm in the worst case (where the OLT is in free-running mode). The upstream signal (denoted CMGPON_U) has a bit rate of 1.24416 Gbit/s, and a frequency accuracy of 32 ppm in the worst case (where the OLT is in free-running mode). It must be noted, however, that the upstream signal is always synchronous to the downstream signal.

The CMGPON_U signal is composed of the regenerated upstream bursts and some 'filler' signal inserted between the bursts. The filler signal is a bit pattern that is well balanced in order to avoid long consecutive identical digits (CID). This continuous signal is transmitted by the R''/S'' interface. The filling bit_pattern is configured by the management system at both the transmitter and receiver. The pattern is subject to the control of the OLT; however, it does need to satisfy a few basic requirements to avoid impacting the physical layer: it should have approximately a 1:1 mark to space ratio, and it should have approximately a 50% transition density. The OEO RE regenerates the received data from ONUs, and therefore does not unscramble the data from the ONUs.